Claims

We claim:

1. A method for evaluating operation of a control unit, the method comprising:

creating a first graphical program that models a physical system, wherein the first graphical program is created in a first graphical program development environment;

deploying the first graphical program on a first computer system for execution;

creating a second graphical program that performs a measurement function, wherein the second graphical program is created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

coupling a control unit to the first computer system;

executing the first graphical program on the first computer system to simulate operation of the physical system, wherein the control unit interacts with the first computer system;

executing the second graphical program to measure characteristics of the operation of the control unit; and

displaying a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

2. The method of claim 1,

wherein the first one or more graphical user interface elements for the first graphical program display one or more parameters related to operation of the first graphical program.

3. The method of claim 2,

wherein the first graphical program comprises a model of the physical system;

wherein the one or more parameters affect operation of the model of the physical system.

4. The method of claim 3, further comprising:

receiving user input to one of the first one or more graphical user interface elements to adjust operation of the first graphical program during said executing the first graphical program;

wherein the user input operates to adjust the model of the physical system.

5. The method of claim 1,

wherein the first one or more graphical user interface elements for the first graphical program display information related to simulation of the physical system.

6. The method of claim 1,

wherein the second one or more graphical user interface elements for the second graphical program display measured characteristics relating to operation of the control unit.

7. The method of claim 1, further comprising:

receiving user input to one of the second one or more graphical user interface elements to adjust operation of the measurement function during said executing the second graphical program.

8. The method of claim 1,

wherein the second one or more graphical user interface elements for the second graphical program display information related to performance of the control unit.

9. The method of claim 1, further comprising:

receiving user input to one of the second one or more graphical user interface elements to adjust operation of the control unit.

10. The method of claim 1, further comprising:

coupling a second computer system to the control unit;

wherein said executing the second graphical program comprises executing the second graphical program on the second computer system.

11. The method of claim 10,

wherein the second graphical program is executable to cause the second computer system to interface with the control unit through one or more instruments to measure characteristics of the control unit.

12. The method of claim 10, further comprising:

displaying the single graphical user interface on one or more of:

a display screen of the first computer system; and

a display screen of the second computer system.

13. The method of claim 1,

wherein said control unit interacting with the first computer system comprises the control unit affecting the simulated operation of the physical system.

14. The method of claim 1,

wherein the first computer system comprises a real-time computer system.

15. The method of claim 1,

wherein the first computer system is a board included in a slot of a second computer system;

wherein said deploying the first graphical program on the first computer system for execution comprises configuring the board to execute the first graphical program.

16. The method of claim 1,

wherein the first computer system is external to a second computer system;

wherein said deploying the first graphical program on the first computer system for execution comprises transferring the first graphical program from the first computer system to the second computer system.

17. The method of claim 1,

wherein said deploying the first graphical program on the first computer system comprises storing the first graphical program in a memory of the first computer system.

18. The method of claim 17,

wherein the memory of the first computer system stores a graphical program execution engine for executing graphical programs created in the first graphical program development environment;

wherein said executing the first graphical program includes executing the graphical program execution engine.

19. The method of claim 1,

wherein said deploying the first graphical program on the first computer system comprises:

converting the first graphical program to machine language code; and

storing the machine language code in a memory of the first computer system.

20. The method of claim 1,

wherein said deploying the first graphical program on the first computer system comprises:

converting the first graphical program to a program in a text-based programming language;

compiling the program in the text-based programming language to machine language code; and

storing the machine language code in a memory of the first computer system.

21. The method of claim 1,

wherein the first computer system includes a programmable hardware element;

wherein said deploying the first graphical program on the first computer system comprises:

converting the first graphical program to a hardware configuration program; and

configuring the programmable hardware element on the first computer system according to the hardware configuration program.

22. The method of claim 1,

wherein said control unit interacting with the first computer system comprises the control unit controlling the first computer system.

23. The method of claim 1, further comprising:

assembling the first one or more graphical user interface elements and the second one or more graphical user interface elements on a display in response to user input.

24. The method of claim 1, further comprising:

assembling the first one or more graphical user interface elements and the second one or more graphical user interface elements on a single window of a display in response to user input.

25. The method of claim 1,

wherein the first one or more graphical user interface elements are selected from the first graphical program development environment; and

wherein the second one or more graphical user interface elements are selected from the second graphical program development environment.

26. The method of claim 1,

wherein the first one or more graphical user interface elements and the second one or more graphical user interface elements are selected from the second graphical program development environment.

27. The method of claim 1,

wherein the first one or more graphical user interface elements and the second one or more graphical user interface elements are selected from the first graphical program development environment.

28. The method of claim 1, further comprising:

creating the single graphical user interface in response to user input, wherein said creating includes selecting the first one or more graphical user interface elements from the first graphical program development environment and selecting the second one or more graphical user interface elements from the second graphical program development environment.

29. The method of claim 1, further comprising:

selecting the first one or more graphical user interface elements from the first graphical program development environment;

creating the single graphical user interface in the second graphical program development environment, wherein said creating comprises including the first one or more graphical user interface elements selected from the first graphical program development environment in the single graphical user interface.

30. The method of claim 29,

wherein said creating the single graphical user interface in the second graphical program development environment includes selecting the second one or more graphical user interface elements from the second graphical program development environment.

31. The method of claim 1,

wherein the single graphical user interface comprises a single window containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

32. The method of claim 1,

wherein the single graphical user interface comprises a single front panel containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

33. The method of claim 1,

wherein the first one or more graphical user interface elements comprise:

one or more graphical user interface elements for receiving user input and providing the user input to the first graphical program; and

one or more graphical user interface elements for displaying output from the first graphical program.

34. The method of claim 1,

wherein the second one or more graphical user interface elements comprise:

one or more graphical user interface elements for receiving user input and providing the user input to the second graphical program; and

one or more graphical user interface elements for displaying output from the second graphical program.

35. The method of claim 1,

wherein said executing the second graphical program is performed concurrently with at least a portion of said executing the first graphical program.

36. The method of claim 1,

wherein the measured characteristics of the operation of the control unit are useful in analyzing operation of the control unit.

37. The method of claim 1,

wherein the first graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the first graphical program.

38. The method of claim 1,

wherein the second graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the second graphical program.

39. The method of claim 1,

wherein the first graphical program comprises a block diagram.

40. The method of claim 1,

wherein the second graphical program comprises a block diagram.

41. The method of claim 1,

wherein the first graphical program comprises one of a data flow diagram or a control flow diagram; and

wherein the second graphical program comprises one of a data flow diagram or a control flow diagram.

42. The method of claim 1,

wherein the first graphical program comprises one of a data flow diagram and/or a state transition diagram;

wherein the second graphical program comprises a data flow diagram.

43. The method of claim 1,

wherein the first graphical program comprises a Simulink diagram.

44. The method of claim 1,

wherein the second graphical program comprises a LabVIEW diagram.

45. The method of claim 1,

wherein the method performs a hardware-in-the-loop simulation.

46. A system for evaluating operation of a control unit, the system comprising:

a first computer system configured to execute a first graphical program, wherein the first graphical program models a physical system, wherein the first graphical program was created in a first graphical program development environment;

a control unit coupled to the first computer system;

a second computer system coupled to the control unit, wherein the second computer system is configured to execute a second graphical program, wherein the second graphical program performs a measurement function, wherein the second

graphical program was created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

wherein the first computer system is operable to execute the first graphical program to simulate operation of the physical system;

wherein the control unit is operable to interact with the first computer system to affect the simulated operation of the physical system;

wherein the second computer system is operable to execute the second graphical program to measure characteristics of operation of the control unit; and

wherein one or more of the first computer system and the second computer system are operable to display a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

47. The system of claim 46,

wherein the first one or more graphical user interface elements for the first graphical program display one or more parameters related to operation of the first graphical program;

wherein the first graphical program comprises a model of the physical system;

wherein the one or more parameters affect operation of the model of the physical system;

wherein the system further comprises a user input device for receiving user input to one of the first one or more graphical user interface elements to adjust operation of the first graphical program;

wherein the user input operates to adjust the model of the physical system.

48. The system of claim 46,

wherein the second one or more graphical user interface elements for the second graphical program display measured characteristics relating to operation of the control unit;

wherein the system further comprises a user input device for receiving user input to one of the second one or more graphical user interface elements to adjust operation of the measurement function.

49. The system of claim 46,

wherein the second one or more graphical user interface elements for the second graphical program display information related to performance of the control unit;

wherein the system further comprises a user input device for receiving user input to one of the second one or more graphical user interface elements to adjust operation of the control unit.

50. The system of claim 46,

wherein the first computer system includes a processor and memory;

wherein the memory of the first computer system stores the first graphical program;

wherein the memory of the first computer system also stores a graphical program execution engine for executing graphical programs created in the first graphical program development environment;

wherein the processor in the first computer system is operable to execute the graphical program execution engine in executing the first graphical program.

51. The system of claim 46,

wherein the first computer system includes a processor and memory;

wherein the memory of the first computer system stores executable code created from the first graphical program; and

wherein the processor in the first computer system is operable to execute the executable code.

52. The system of claim 46,

wherein the first computer system includes a programmable hardware element;

wherein the programmable hardware element is configured with a hardware configuration program based on the first graphical program.

53. The system of claim 46,

wherein the single graphical user interface comprises a single window containing the first one or more graphical user interface elements and the second one or more graphical user interface elements.

54. The system of claim 46,

wherein the first graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the first graphical program.

55. The system of claim 46,

wherein the second graphical program comprises a plurality of interconnected nodes which visually indicate functionality of the second graphical program.

56. The system of claim 46,

wherein the first graphical program comprises a data flow diagram; and

wherein the second graphical program comprises one of a data flow diagram or a control flow diagram.

57. The system of claim 46,

wherein the system performs a hardware-in-the-loop simulation.

58. A method for performing a hardware-in-the-loop simulation, the method comprising:

creating a first graphical program that models a physical system, wherein the first graphical program is created in a first graphical program development environment;

deploying the first graphical program on a first computer system for execution;

creating a second graphical program that performs a measurement function, wherein the second graphical program is created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

coupling a control unit to the first computer system;

executing the first graphical program on the first computer system to simulate operation of the physical system, wherein the control unit interacts with the first computer system;

executing the second graphical program to measure characteristics of the operation of the control unit; and

displaying a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

59. A system for performing a hardware-in-the-loop simulation, the system comprising:

a first computer system configured to execute a first graphical program, wherein the first graphical program models a physical system, wherein the first graphical program was created in a first graphical program development environment;

a control unit coupled to the first computer system;

a second computer system coupled to the control unit, wherein the second computer system is configured to execute a second graphical program, wherein the second graphical program performs a measurement function, wherein the second

graphical program was created in a second graphical program development environment, wherein the second graphical program development environment is different than the first graphical program development environment;

wherein the first computer system is operable to execute the first graphical program to simulate operation of the physical system;

wherein the control unit is operable to interact with the first computer system to affect the simulated operation of the physical system;

wherein the second computer system is operable to execute the second graphical program to measure characteristics of operation of the control unit; and

wherein one or more of the first computer system and the second computer system are operable to display a single graphical user interface comprising a first one or more graphical user interface elements for the first graphical program and a second one or more graphical user interface elements for the second graphical program.

60. The system of claim 59,

wherein the control unit is designed to control the physical system that the first graphical program models.